EVAPORATIVE EMISSIONS IN MOBILE6

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MOBILE6 Workshop

June 29-30, 1999

Sources of Evaporative Emissions

- **Hot Soak Emissions**
- *Crankcase Emissions*
- *Refueling Emissions*
- *Resting Loss Emissions*
- *Diurnal Emissions*
- *Running Loss Emissions*

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Overview of This Presentation

- **Stratification**
  - » **Of Analyses**
  - » *Weighting Factors*
- *Sources of Evaporative Emissions*
  - » *Diurnal Emissions*
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Stratification

Of Analyses

Stratification for Each Source

For each type of source, the evaporative emissions were estimated separately for each of the following four strata:

- **ALL "gross liquid leakers"**
- **NOT "gross liquid leakers"**
  - » **Passing both purge & pressure**
  - » **Failing the pressure test**
  - » **Failing only the purge test**

Stratification

Weighting Factors

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For each of the four strata, the incidence of its occurrence (frequency) is estimated as a logistic growth function of vehicle age.

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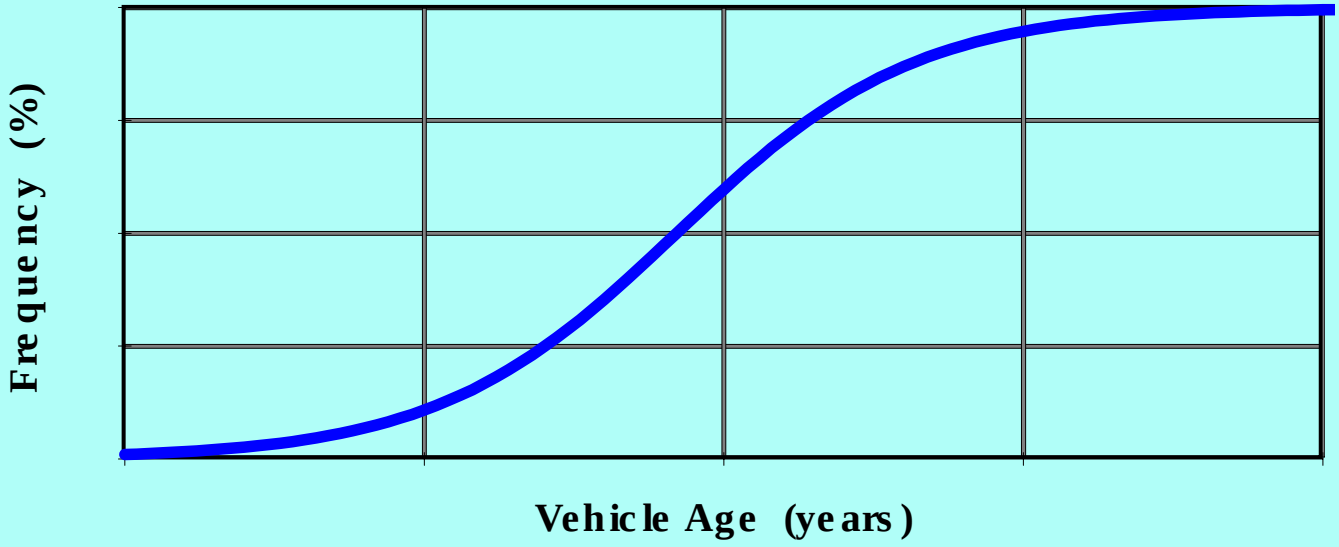


“Gross Liquid Leakers”

The First of the Four Strata

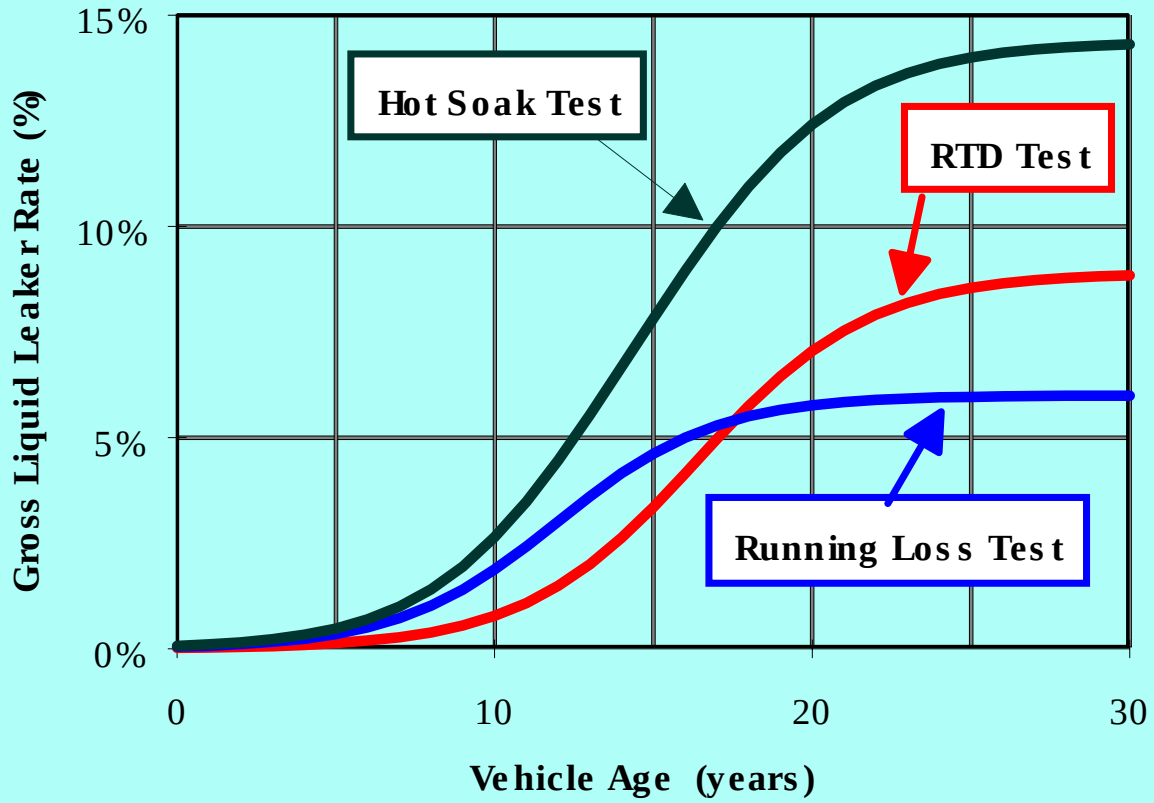
- Many vehicles may have leaks of liquid gasoline, but NOT all are “Gross Liquid Leakers”
- Only the highest emitting of the leakers are “Gross Liquid Leakers”
- Some vehicles may be “Gross Liquid Leakers” on only some of the tests

“Gross Liquid Leakers”

These are vehicles with substantial leaks of liquid gasoline (as opposed to vapor leaks) and having:

- **Resting Loss Emissions ≥ 2.0 grams/hr, or**
- **Diurnal Emissions ≥ 25.0 grams/day, or**
- **Hot Soak Test ≥ 10.0 grams/test, or**
- **Running Loss Test ≥ 7.0 grams/mile**

"Gross Liquid Leakers" Frequency (From M6.EVP.009)



"Gross Liquid Leakers"
Mean Emissions

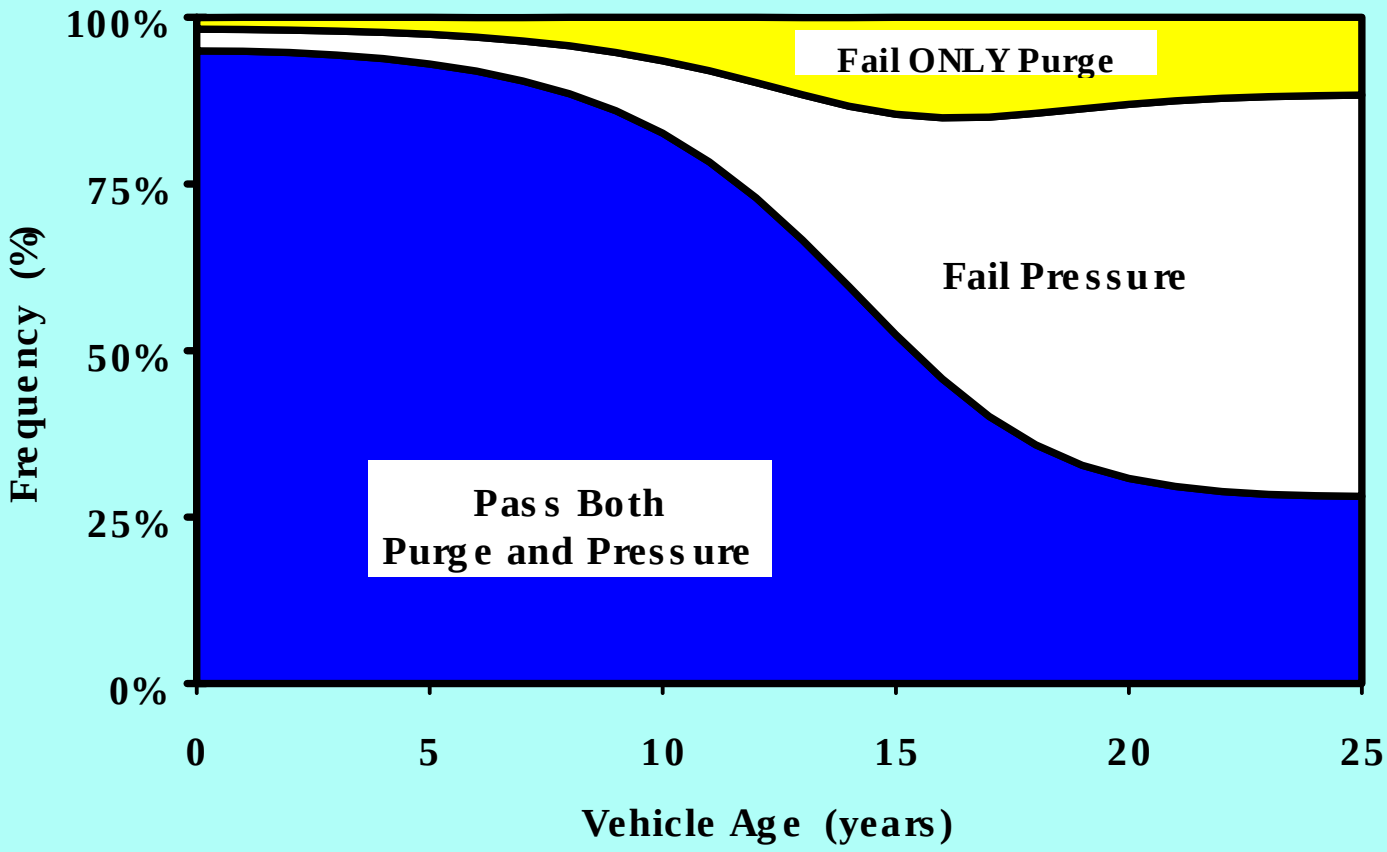
Mean emissions from each source are:

- Resting Loss Emissions = 9.16 grams/hr
- Diurnal Emissions = 104.36 grams/day
- Running Loss Test* = 17.65 grams/mile
- Hot Soak Test*
  - » Carbureted = 16.95 grams/test
  - » TBI = 45.00 grams/test
  - » PFI = 57.14 grams/test

Weighting Factors
Vehicles NOT “Gross Liquid Leakers”

- Data Sources
  - » I/M Lanes in Indiana and Arizona
- Statistical Model
  - » Logistic Growth Curves
- Compare Purge/Pressure Strata

Weighting Factors
Compare Purge & Pressure Strata



Sources of Evaporative Emissions

Diurnal Emissions

Diurnal Emissions

- Full 24-Hour Diurnal
- Multi-Day Diurnals
- Hourly Diurnals
- Interrupted Diurnals

Diurnal Emissions

- **Full 24-Hour Diurnal**
  - **1995 and Older Vehicles -- No Change from Previous Workshop**
  - *1996 and Newer Vehicles -- New*
- *Multi-Day Diurnals*
- *Hourly Diurnals*
- *Interrupted Diurnals*

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- *Interrupted Diurnals*

1996 and Newer Vehicles
("Enhanced EVAP" Vehicles)

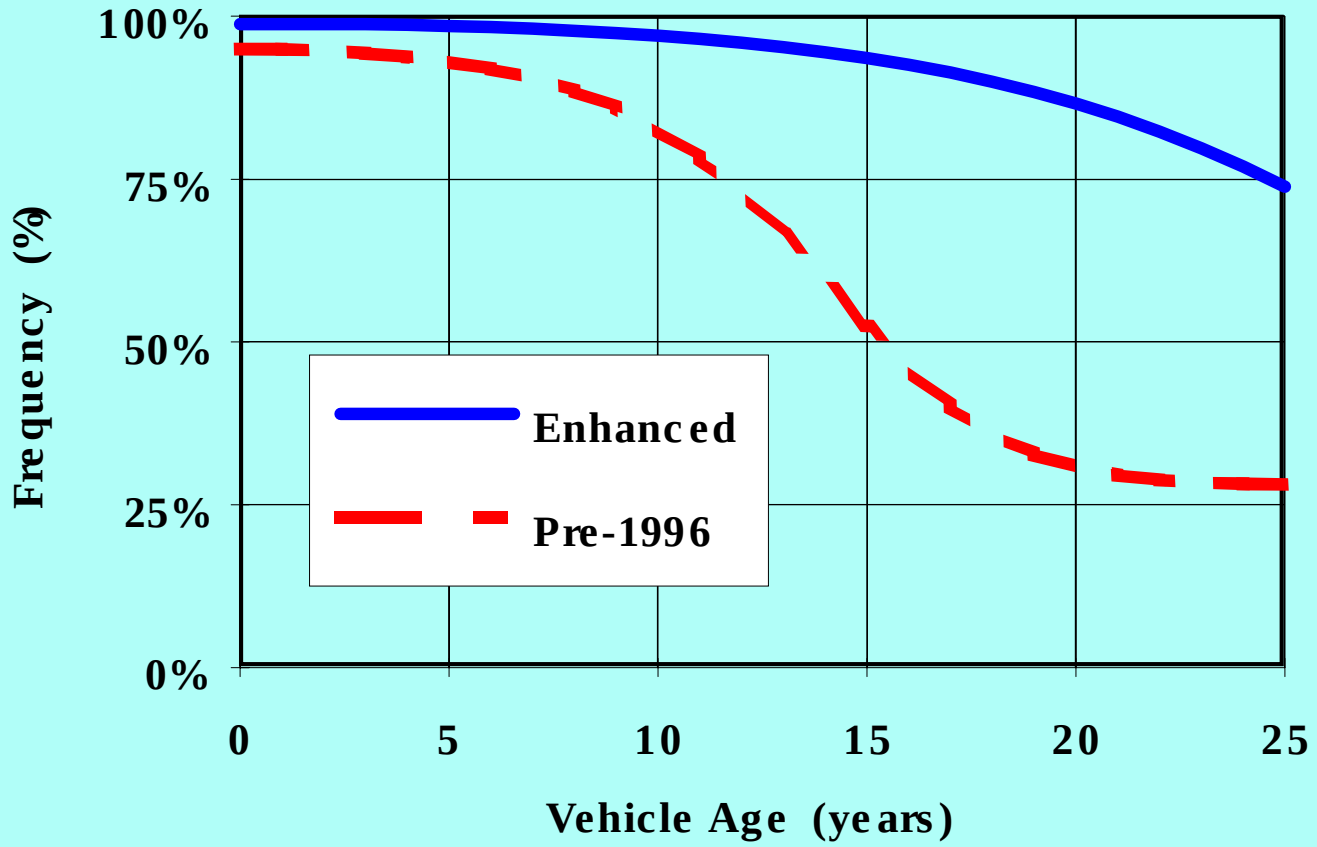
- More Stringent Standards
  - » Phasing-In 1996-98 Model Years
  - » Fully Applicable 1999 and Newer
- Expected Effects of Standards
  - » On Weighting Factors
  - » On Emission Levels

Enhanced EVAP Vehicles

Basic Assumptions (from Report M6.EVP.005 that is posted on website):

- **Effects on Distribution of Purge/ Pressure Strata**
- *Effects on Average (Mean) Emission Level of Each Strata*

Enhanced EVAP Vehicles
Passing Both Purge & Pressure Tests



Enhanced EVAP Vehicles

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- *Effects on Distribution of Purge/ Pressure Strata*
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Diurnal Emissions

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- *Hourly Diurnals*
- *Interrupted Diurnals*

Multi-Day Diurnals

Multiplicative factors (by strata) for second and third days.

(Unchanged After Third Day)

(Report No. M6.EVP.003)

Multiplicative Factors
Multi-Day RTD Tests

- **Fuel-Injected -- Passing Both**
  - » Day_2 = 1.365 * Day_1
  - » Day_3 = 1.312 * Day_2 = 1.791 * Day_1
- **Fuel-Injected -- Failing Either**
  - » Day_2 = 1.133 * Day_1
  - » Day_3 = 1.000 * Day_2 = 1.133 * Day_1
- **All Other Strata (i.e., Carbureted)**
  - » No Statistically Significant Changes from Day-to-Day

Diurnal Emissions

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- **Hourly Diurnals**
- *Interrupted Diurnals*

Hourly Diurnals

Revised Approach Based On:

- Purge / Pressure Strata
- Fuel Delivery System (Carbureted versus FI)
- Temperature Cycle
- Fuel RVP
- Report Number: M6.EVP.002 -- New Version

Diurnal Emissions

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  - *1996 and Newer Vehicles -- New*
- *Multi-Day Diurnals*
- *Hourly Diurnals*
- **Interrupted Diurnals**

Interrupted Diurnals

- Situation in which the vehicle operation (driving) occurs after the daily temperature rise has already begun.
- Calculations are based on ambient temperature at the time the diurnal emissions resume.

Sources of Evaporative Emissions

Running Loss Emissions

Running Loss Emissions

- Evaporative Emissions Produced During Vehicle Operation
- To Calculate, Subtract Resting Loss Emissions From Running Loss Test Results
- See Report Number: M6.EVP.008

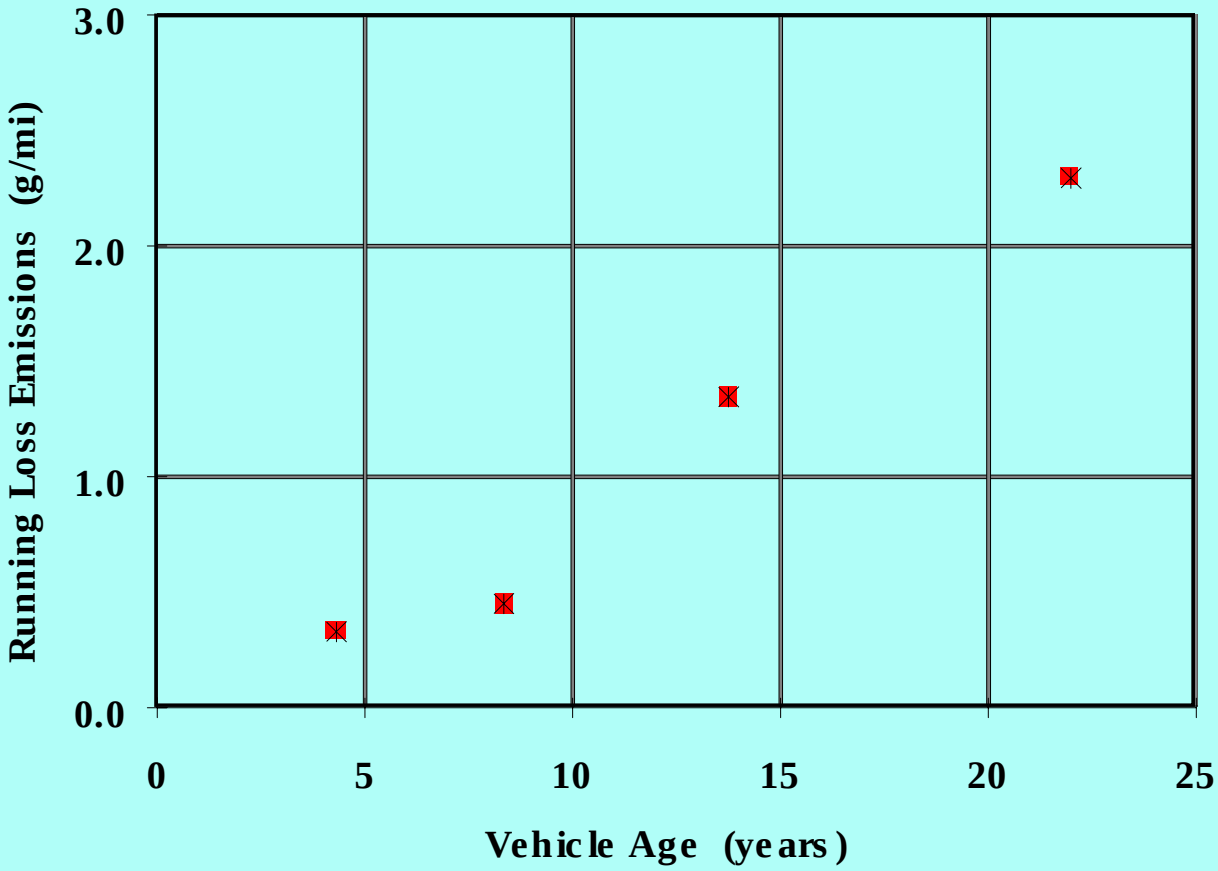
Running Loss Emissions

- EPA's Test Data Primarily Used for MOBILE5
- Additional Testing Run for CRC
  - »200 Test Vehicles
  - »Limited Range of Ambient Temperatures, Fuel RVP, and Driving Cycle

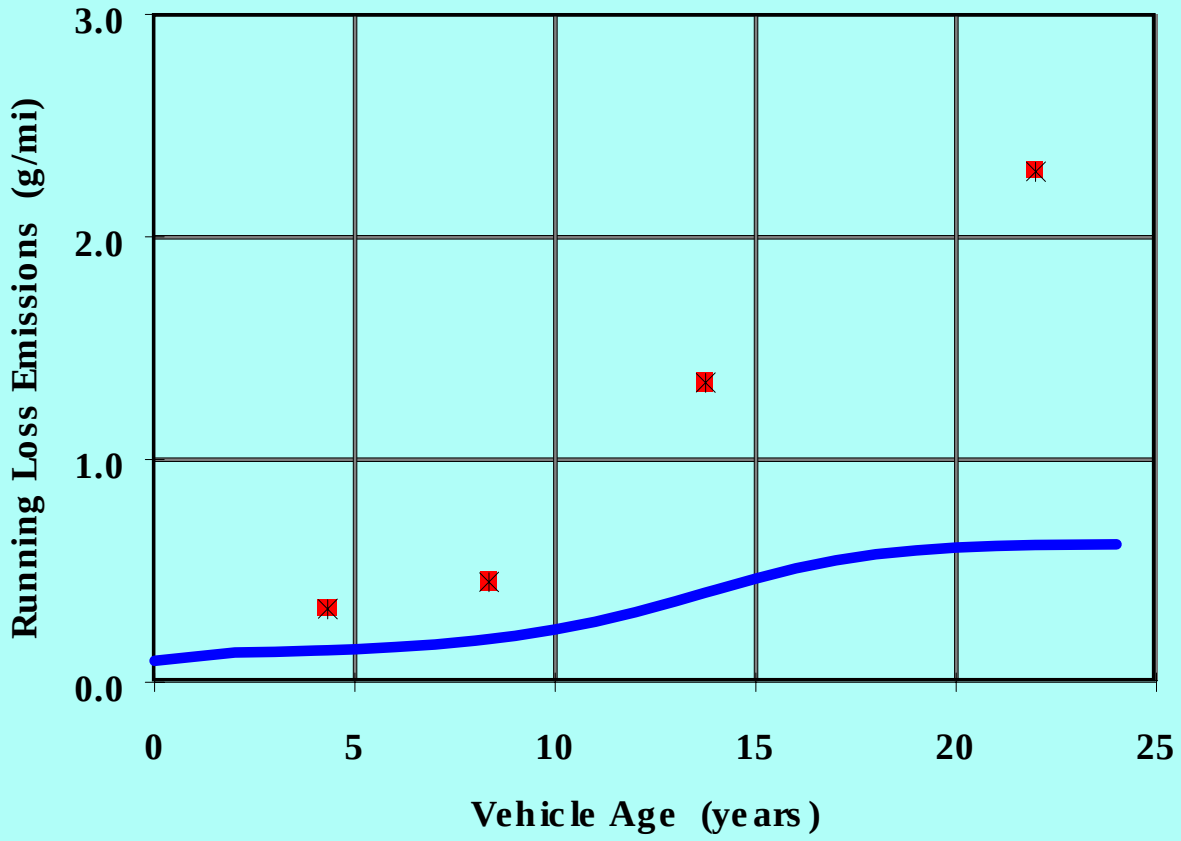
Running Loss Emissions

Comparing the predictions of resting loss from the MOBILE5 model (adjusted for new Purge and Pressure rates) to results from CRC's 200-vehicle testing.

Running Loss Emissions
Mean Emissions of CRC Testing

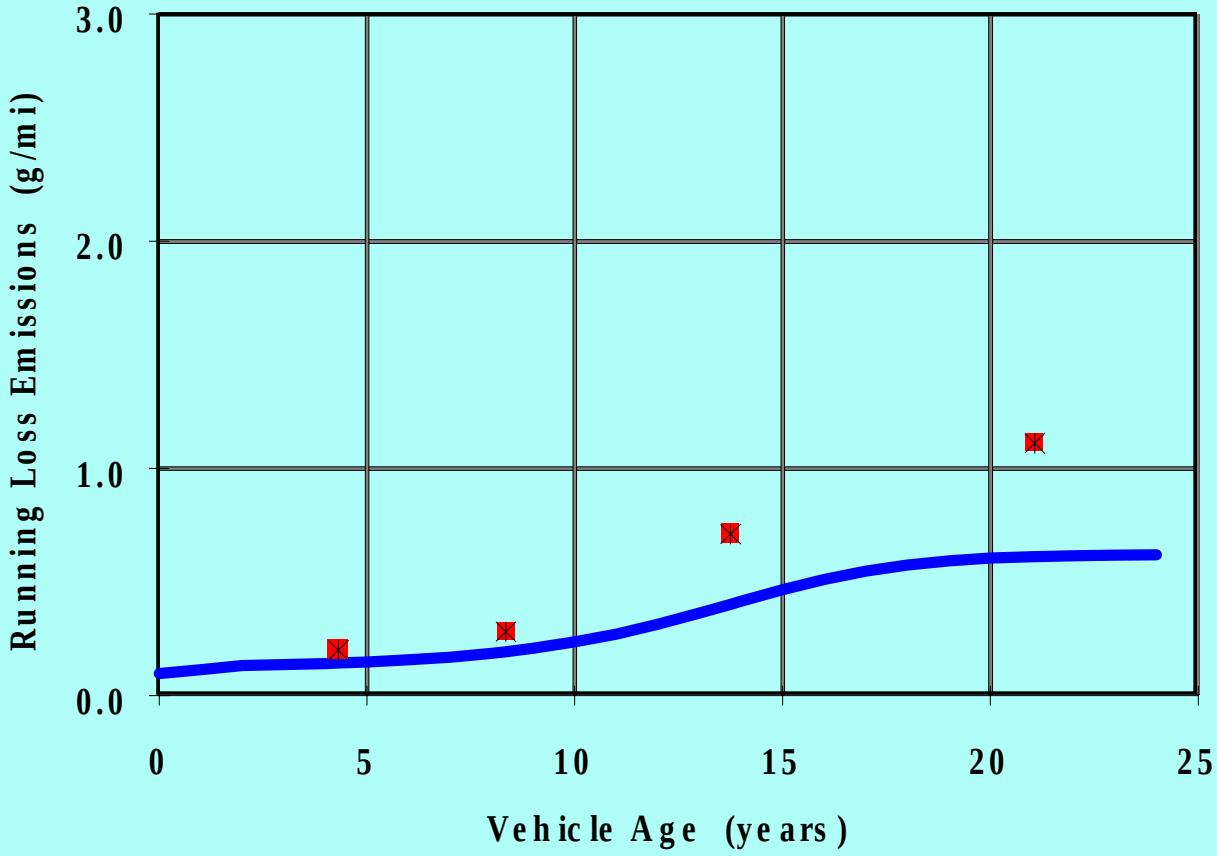


Running Loss Emissions
Comparison Between CRC Data and M5



Running Loss Emissions

Removing "Gross Liquid Leakers" from CRC Data



Running Loss Emissions
Proposals for MOBILE6

- For Vehicles Not "Gross Liquid Leakers," Use MOBILE5 Predictions Within Each Purge/Pressure Stratum
- Weight Those Three Strata With the New Stratum of "Gross Liquid Leakers"

References

- **M6.EVP.001 --** "Evaluating Resting Loss and Diurnal Evaporative Emissions Using Real Time Diurnal Tests"
- **M6.EVP.002 --** "Modeling Hourly Diurnal and Interrupted Diurnal Emissions Based on Real-time Data"
- **M6.EVP.003 --** "Evaluating Multiple Day Diurnal Evaporative Emissions Using RTD Tests"

References (Continued)

- **M6.EVP.004 --** "Update of Hot Soak Emissions Analysis"
- **M6.EVP.005 --** "Modeling Diurnal and Resting Loss Emissions from Vehicles Certified to Enhanced Evaporative Standards"
- **M6.EVP.006 --** "Estimating Weighting Factors for Evaporative Emissions in MOBILE6"

References (Continued)

- **M6.EVP.007** -- "Hot Soak Emissions as a function of Soak Time"
- **M6.EVP.008** -- "Estimating Running Loss Evaporative Emissions in MOBILE6"
- **M6.EVP.009** -- "Evaporative Emissions of Gross Liquid Leakers in MOBILE6"